

Strengthening Research Experiences for Undergraduate STEM Students

Committee

James M. Gentile

Chair

JAMES GENTILE is Dean for the Natural & Applied Sciences at Hope College in Holland, MI., and the Past President of Research Corporation for Science Advancement, a Tucson, AZ-based foundation dedicated to science since 1912. A geneticist by training, Dr. Gentile has conducted extensive research on the role of metabolism in the conversion of natural and xenobiotic agents into mutagens and carcinogens, with funding from the National Institutes of Health, the National Science Foundation, the U.S. Environmental Protection Agency, and the World Health Organization, among many other public and private foundations. He is the author of more than 150 research articles, book chapters, book reviews and special reports in areas of scientific research and higher education, and he is a frequent speaker on issues involving the integration of scientific research and higher education. He is the former Editor-in-Chief of the international journal Mutation Research and Past President of the US Environmental Mutagen Society and the International Association of Environmental Mutagen Societies. He serves on numerous Boards, including the Biosphere2 Governing Board, the Science Friday Foundation, the Cures Now Foundation, and the American Association of Colleges & Universities Project Leap Initiative. He received his B.A. in Biology from St. Mary's College in Winona, MN. After he received his Ph.D. in genetics from Illinois State University he undertook postdoctoral studies in the Department of Human Genetics at the Yale University School of Medicine.

Ann Beheler

Member

ANN BEHELER is the Executive Director for Emerging Technology Grants at Collin County Community College, near Dallas, Texas. She leads the National Information, Security, and Geospatial Technologies Consortium, an almost \$20 million grant from the Trade Adjustment Assistance Community College and Career Training program at the Department of Labor, and a \$4.4 million National Science Foundation grant for the National Convergence Technology Center. Dr. Beheler has been in the Information Technology industry for over 30 years. She has corporate experience, has led her own consulting firm, has created and taught in one of the first networking degree programs in Texas, and has previously managed IT-related divisions and grants ranging from \$1-\$20 million in community colleges in Texas and California. Prior to her current position, she was Vice President of Academic Affairs for Porterville College, responsible for all instruction at the college, and prior that she was a Dean at both Orange Coast College in California and at Collin College. Among other things, Dr. Beheler is known for effectively bringing together business and industry using a streamlined process to identify with them the knowledge, skills, and abilities (KSAs) they predict will be needed by “right-skilled” job candidates in the future. She then works with faculty to align curriculum such that those who complete certificates and degrees in IT have the knowledge, skills, and abilities that will make them readily employable in high-paying IT positions. Dr. Beheler received a B.S. in Math from Oklahoma State University, a M.S. in computer science from Florida Institute of Technology, and a Ph.D. in community college leadership from Walden University.

Janet Branchaw

Member

JANET BRANCHAW is Assistant Professor of Kinesiology at the University of Wisconsin-Madison. She is the Director of the Wisconsin Institute for Science Education and Community Engagement (WISCIENCE), the Associate Director of the NIH-funded Mentor Training Core of the National Research Mentoring Network, and the Chairperson of NSF’s Biology Research Experiences for Undergraduates (REU) Leadership Committee. Branchaw directs a NSF-funded REU Site program, the Integrated Biological Sciences Summer Research Program, and has developed training curricula for research mentors, Entering Mentoring, 2nd ed., and undergraduate research mentees, Entering Research. She also led a project to develop a common assessment tool for use across NSF’s REU programs. Her scholarship focuses on the development, implementation, and evaluation of innovative approaches to undergraduate science education, with a special emphasis on undergraduate research, assessment of student learning and broadening participation in science among underrepresented groups. She has taught undergraduate, graduate and medical physiology and a freshman seminar course in biology. Her early career research was in cellular neurophysiology and membrane biophysics. She holds a B.S. in Zoology from Iowa State University and a M.S. and Ph.D. in Physiology from the University of Wisconsin - Madison.

Deborah F. Carter

Member

DEBORAH FAYE CARTER is Associate Professor of Education in the School of Educational Studies, at Claremont Graduate University. Previously, she was an assistant professor of higher education at Indiana University from 1997-2004 where she also was program chair of the Higher Education and Student Affairs program. In 2004, Dr. Carter moved to the University of Michigan where she was an associate professor in the Center for the Study of Higher and Postsecondary Education (CSHPE). She was Director of CSHPE from 2006-2009. Among her honors, Dr. Carter won the Bobby Wright Dissertation of the Year Award in 1998 from the Association for the Study of Higher Education (ASHE) and she received the Harold Johnson Diversity Award in 2011 from the University of Michigan. Dr. Carter has been a member of and/or chaired several committees in national organizations like the American Educational Research Association (AERA) and the Association for the Study of Higher Education (ASHE), American College Personnel Association (ACPA). Her areas of research include the impact of college on students, especially students of color and/or low-income students, students' degree aspirations, students' transition to college, and the effects of undergraduate research on students' major choices and graduate school attendance. Her teaching interests include access & equity in higher education, impact of college on students, race and gender in higher education, and mentoring. She holds a B.A. in Sociology and Psychology from the University of California, Santa Cruz and an M.A. and Ph.D. in Higher Education from the School of Education at the University of Michigan.

Melanie Cooper

Member

MELANIE COOPER is the Lappan-Phillips Professor of Science Education and Professor of Chemistry at Michigan State University. Her research has focused on improving teaching and learning in large enrollment general and organic chemistry courses at the college level, and she is a proponent of evidence-based curriculum reform for example the NSF supported "Chemistry, Life, the Universe & Everything" curriculum for general chemistry. She has also developed technological approaches to formative assessment that can recognize and respond to students free-form drawings such as the beSocratic system. She is a Fellow of the American Chemical Society and the American Association for the Advancement of Science, and the National Research Council Advisory Board on Science Education (BOSE). She was also member of the Leadership team for the Next Generation Science Standards (NGSS). She has received a number of awards including the ACS Award for Achievement in Research on Teaching and Learning in Chemistry (2014), the Norris award for Outstanding Achievement in Teaching of Chemistry (2013), and the Outstanding Undergraduate Science Teacher Award from the Society for College Science Teaching (2011). She earned her B.S. M.S. and Ph.D. in chemistry from the University of Manchester, England.

Edward Coyle

Member

EDWARD J COYLE is the John B. Peatman Distinguished Professor of Electrical and Computer Engineering at Georgia Tech and a Georgia Research Alliance Eminent Scholar. He is the Founder and Director of the Vertically-Integrated Projects (VIP) Program, which integrates research and education by embedding large-scale, long-term teams of undergraduates in the research efforts of faculty and their graduate students. He is also the Founder and Director of the VIP Consortium, a group of 15 universities committed to growing and disseminating the VIP Program in order to achieve systemic reform of STEM education. Dr. Coyle was a co-recipient of the U.S. National Academy of Engineering's 2005 Bernard M. Gordon Prize for Innovation in Engineering and Technology Education. He was also a co-recipient of the American Society for Engineering Education's 1997 Chester F. Carlson Award for Innovation in Engineering Education and the IEEE Signal Processing Society's 1986 Best Paper Award. In 1998, Dr. Coyle was elected a Fellow of the IEEE for his contributions to the theory of nonlinear signal processing. His current research interests include undergraduate education, signal and image processing, and wireless sensor networks. Dr. Coyle received his B.S. degree in electrical engineering from the University of Delaware and M.S. and Ph.D. degrees in electrical engineering and computer science from Princeton University.

Sarah C. Elgin

Member

SARAH C. R. ELGIN is Viktor Hamburger Professor of Arts and Sciences, a professor of biology, a professor of genetics, and a professor of education at Washington University in St. Louis. Her research in fruit flies focuses on epigenetics, gene regulation, and heterochromatin formation. In 2002 Dr. Elgin became a Howard Hughes Medical Institute Professor with the goal of integrating primary research in genomics into the college curriculum, using *Drosophila* as the model system. This project has been expanded and disseminated as the Genomics Education Partnership (GEP), a consortium of over 100 college and university faculty with similar goals. GEP undergraduates participate in sequence improvement and annotation projects with the goal of publishing the results in primary research journals; over 900 undergraduates are co-authors on GEP papers. Dr. Elgin has served on the NRC's Board on Life Sciences since 2011. Currently, she is serving as the chair of the NRC committee on Integrating Discovery-Based Research into the Undergraduate Curriculum: A Convocation. The work of that committee will inform this consensus study. Dr. Elgin has received awards for her contributions to science education from ASCB, ASBMB, and GSA, and is a Fellow of AAAS and the American Academy of Arts & Sciences. She currently serves on the editorial boards of *Chromatin & Epigenetics* and *CBE-Life Science Education*, as well as the SAB for iPLANT, the Advisory Board for CourseSource, and as a Director of the Genetics Society of America. Dr. Elgin earned a B.A. in chemistry from Pomona College and her Ph.D. in biochemistry from the California Institute of Technology.

Mica Estrada

Member

MICA ESTRADA is an Assistant Professor at the University of California at San Francisco's School of Nursing and Research Faculty at California State University, San Marcos. Her area of expertise is social influence, including the study of identity, forgiveness, intergroup relations, and integrative education. Dr. Estrada is the co-PI for a longitudinal, theory-driven evaluation of minority science training programs funded by the National Institutes of Health. Her recent publication from this study assessed how a student's orientation towards the scientific community predicts their perseverance in and commitment to that social community. In addition, she is currently co-PI on a National Science Foundation Climate Change Education Partnership grant that provides educational tools and learning opportunities to San Diego regional leaders and residents regarding the changing climate. She also remains active in her local community promoting the Quince Project for Latina teens. A common characteristic of Dr. Estrada's work is designing and empirically testing interventions that can change individual behavior, social norms, and community consciousness. She received the Leadership Institute Graduate Award from the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) in 2013. Dr. Estrada earned her B.A. in Psychology from the University of California, Berkeley and her Ph.D. in Social Psychology from Harvard University.

Eli Fromm

Member

ELI FROMM (NAE) is Roy A. Brothers University Professor and Professor of Electrical and Computer Engineering at Drexel University. Dr. Fromm has been principal investigator of a number of bioengineering research projects involving implantable transmitters and sensors and their use in physiologic measurements as well as inter and intra-institutional undergraduate education research initiatives. At Drexel University Dr. Fromm has served in academic leadership including Vice President for Educational Research, Vice Provost for Research and Graduate Studies, Interim Dean of Engineering, and Interim Head of the Biosciences Department. He has also held positions with the General Electric and E.I. DuPont companies; has been a staff member of the Science Committee of the U.S. House of Representatives as a Congressional Fellow; a Program Director at the National Science Foundation; and a Visiting Scientist with the Legislative Office of the Research Liaison of the Pennsylvania House of Representatives. Dr. Fromm is member of the National Academy of Engineering, a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), a Charter Fellow of the American Institute of Medical and Biological Engineering (AIMBE), a Fellow of the American Society for Engineering Education (ASEE), and a Fellow of the International Engineering Consortium (IEC). He is the inaugural recipient of the Bernard M. Gordon Prize from the National Academy of Engineering in 2002 for his significant contributions to engineering and technology education. He has received numerous other awards and honors from such organizations as the IEEE, ASEE, Accreditation Board for Engineering and Technology (ABET), the Smithsonian Institution, Drexel University, Thomas Jefferson University, and others. He received his B.S. in Electrical Engineering from Drexel University, his M.S. in Biomedical Engineering from Drexel University, and his Ph.D. in Physiology and Bioengineering from Thomas Jefferson University.

Ralph M. Garruto

Member

RALPH GARRUTO (NAS) is Research Professor in Biomedical Anthropology at the State University of New York, Binghamton. Dr. Garruto is a human population biologist whose research focuses on natural experimental models of disease, using both field and laboratory approaches. His cross-disciplinary research and interests include studies of neurodegenerative disorders including Amyotrophic Lateral Sclerosis and Parkinson's Disease, also food chain disorders, health transition studies, obesity and bionutrition, malaria, Lyme and other tick-borne diseases, and prion diseases, especially Chronic Wasting Disease. Currently he has field research projects in Micronesia, Vanuatu, Ukraine, China, Siberia, and upstate New York. His laboratory focus is on cellular and molecular mechanisms of neuronal degeneration, host-pathogen interactions, experimental modeling, use of mitochondrial DNA in biomedical and evolutionary studies, and the study of gene-environment interactions in health and disease. He currently has 50 undergraduates associated with his laboratory. They work in teams with graduate students and he meets with each at least weekly. The undergraduates typically stay for several years working in the field, lab, and/or modeling risk of infection. He received his B.S. in zoology and M.A. in anthropology from Pennsylvania State University. His Ph.D. was also earned at Pennsylvania State University, in anthropology (human population biology).

Eric Grodsky

Member

ERIC GRODSKY is Associate Professor of Sociology at the University of Wisconsin, Madison. He is an expert in the sociology of education and in quantitative methods. He has done extensive research on understanding the pathways students take into and through higher education; including how the effects of grades, test scores and course taking on college attendance and completion have changed over time. He has also done work to evaluate the relationship between STEM course taking, degree completion, and labor market outcomes for students who complete sub-baccalaureate degrees or who start but fail to complete their postsecondary credential. He serves on the editorial board of the journal Educational Evaluation and Policy Analysis, as the deputy editor for the journal Sociology of Education, and is an incoming Associate Editor for the American Educational Research Journal. In the past he has served as chair of the Sociology of Education Special Interest Group for the American Educational Research Association and as President of the Sociology of Education Association. He will chair the Sociology of Education section of the American Sociological Association in 2015-2016. He received his B.A. in Anthropology and Sociology from Kenyon College, his M.S. in Sociology from the University of Wisconsin, Madison, and his Ph.D. in Sociology with a minor in Education Policy from the University of Wisconsin, Madison.

James Hewlett

Member

JAMES HEWLETT is a Professor of Biology at Finger Lakes Community College (FLCC).

Professor Hewlett currently serves as the Director of Biotechnology/ Biomanufacturing at FLCC. In addition to teaching, he serves as the New York Hub Director of the Northeast Biomanufacturing Center and Collaborative. He also serves on the editorial board of the National Center for Case Study Teaching in Science and the editorial board of the journal CBE-Life Sciences Education. He serves on the advisory board for Rochester Institute of Technology's Center for Bioscience Education and Technology and is a member of the steering committee for the University of Georgia's RCN-UBE Course-based Undergraduate Research Experiences Network. Professor Hewlett's active areas of research include molecular indicators of stress in corals and the use of biomarkers for the early detection of symbiotic breakdown, the employment of non-invasive DNA-based mark and recapture methods in eastern red-tail hawk and North American black bear population studies, and the study of macro-level indicators of stress in tropical coral reef ecosystems. Professor Hewlett leads the Community College Undergraduate Research Initiative (CCURI), which uses an inquiry-based teaching model where students are exposed to scientific investigations using a case study pedagogy in introductory biology courses. This experience leads to a hands-on research experience resulting from questions about or related to the cases. CCURI provides resources for 26 institutional partners throughout the United States and provides a diverse portfolio of support services to institutions and faculty. Professor Hewlett earned a B.S. in Biology from Bucknell University and a M.S. in Physiology/Marine Science from the University of Connecticut.

Laird Kramer

Member

LAIRD KRAMER is Director of the STEM Transformation Institute and Professor of Physics in the College of Arts & Sciences at Florida International University. His work focuses on facilitating institutional change through implementation of, and research on, evidence-based educational practices. He led transformation of the undergraduate physics experience at FIU, creating more well-prepared majors through implementation of modeling instruction-based studio physics courses, establishment of student-centric methodologies, and establishment of a high school/university research and learning community. Kramer has fostered a community that enables future teachers to implement their instructional craft, built by operating more than a decade of intensive, summer professional development in modeling instruction for high school teachers. He earned a B.A. in physics from the George Washington University and a Ph.D. in physics from Duke University.

Marcia C. Linn

Member

MARCIA LINN is a professor of cognition and development specializing in education in mathematics, science, and technology in the Graduate School of Education at the University of California, Berkeley where she investigates science teaching and learning, gender equity, and design of learning environments. She leads the Technology-Enhanced Learning in Science Community that includes users of the Web-based Inquiry Science Environment. She is a member of the National Academy of Education and a Fellow of the American Association for the Advancement of Science, the American Psychological Association, and the Association for Psychological Science. She has served as Chair of the AAAS Education Section and as President of the International Society of the Learning Sciences. She has twice been a fellow at the Center for Advanced Study in Behavioral Sciences. In 1998, the Council of Scientific Society Presidents selected her for its first award in educational research. In 1994, the National Association for Research in Science Teaching presented her with its Award for Lifelong Distinguished Contributions to Science Education. The American Educational Research Association bestowed on her the Willystine Goodsell Award in 1991 and the Women Educator's Research Award in 1982. Twice she has won the Outstanding Paper Award of the Journal of Research in Science Teaching (1975 and 1983). She has accepted invitations to contribute as a Fulbright Professor at the Weizmann Institute in Israel; as a Visiting Fellow at University College, London; and as a Visiting Fellow at the Institute J. J. Rousseau in Geneva, Switzerland, where she worked with Jean Piaget. Her board service includes the American Association for the Advancement of Science board, the Graduate Record Examination board of the Educational Testing Service, the McDonnell Foundation Cognitive Studies in Education Practice board, and the Education and Human Resources Directorate at the National Science Foundation. She has a B.A. in Psychology with emphasis on Statistics and a Ph.D. in Educational Psychology, both from Stanford University.

Linda Reinen

Member

LINDA REINEN is Associate Professor of Geology at Pomona College. Her primary research focuses on the mechanical behavior of crustal rocks. She is particularly interested in how slip is accommodated on faults, either through the generation of earthquake or by stable fault creep. Her research to date has focused on faults containing serpentinite, a rock common to portions of the San Andreas Fault and other creeping fault segments. She employs a variety of methods to address these questions, including numerical models of earthquake cycles, laboratory experiments, and field studies of naturally deformed faults and shear zones. Dr. Reinen regularly teaches courses in Geological Hazards, Hydrogeology and Structural Geology, and also holds a research position at the University of California, Riverside. In addition to pursuing her own research, Dr. Reinen has worked with students on hydrology and planetary geology research projects conducted in Idaho and Virginia, and in the summer of 1998 she directed a multi-student project focused upon understanding a serpentinite body along the Big Sur coastline of California. She is a member of the Council for Undergraduate Research, the National Association for Geology Teachers, the Geological Society of America, and the American Geophysical Union. She received a B.S. and M.S. in Geology from the University of Massachusetts and a Ph.D. in Geology from Brown University.

Heather Thiry

Member

HEATHER THIRY is a Researcher at the Ethnography and Evaluation Research Center of the University of Colorado, Boulder. She has conducted research and evaluation studies on the underrepresentation of women and minorities in STEM disciplines, the professional socialization of graduate students, and pedagogical reform initiatives in science, technology, engineering, and mathematics education. Her research interests include the social and cultural factors that enhance or hinder educational reform, scientific career paths and career decision-making, and the underrepresentation of women and minorities in the sciences. She has published journal articles on the professional development of education-engaged scientists and the overrepresentation of women scientists in teaching and outreach. Her current work includes a focus on learning progressions, when students are most receptive to learning certain skills along the path from novice to experienced researcher. Thiry has taught educational foundations and policy courses for pre-service teachers. She directed a service-learning program at a community college in California and served as a counselor in an urban elementary school. She has also run several programs at the K-12 and community college levels that provided case management and social services for low-income youth and first-generation college students. Dr. Thiry received her Ph.D. in Educational Foundations, Policy and Practice from the University of Colorado, Boulder.